Research & Innovation

Driving Clean Water Innovation with Solar-Driven Technologies

The Department of Applied Physics and the Materials Research Centre have advanced knowledge in interfacial solar steam generation (ISSG), a promising solution to the escalating challenge of global water scarcity. By harnessing solar energy, ISSG enables efficient desalination and purification, making it highly relevant for sustainable access to clean water.

The study offers a comprehensive review of the mechanisms that underpin ISSG, with a focus on the photothermal behaviours of different materials, including nanoparticles that enhance vapor generation. It also investigated the influence of substrate design and composition on evaporation efficiency, with innovations such as multi-surface evaporators showing potential to maximise energy capture. The research further evaluated thermal management strategies, proposing new water transport pathways to improve heat distribution and efficiency.

Beyond efficiency, the review addresses critical challenges including salt accumulation, biofouling, corrosion, and oil fouling, while offering insights into mitigation strategies. By integrating these perspectives, ISSG demonstrates strong potential across applications ranging from seawater desalination and wastewater treatment to oil-water separation and sterilisation, supporting cleaner water solutions for both industrial use and healthcare while addressing one of the world's most pressing sustainability challenges.

Reinventing Sanitation with Autonomous Washroom Cleaning Technology

Developed by the PolyU start-up ZeeqClean Technology Limited, the ZC-01™ is an innovative commercial washroom cleaning robot designed to meet the growing cleaning needs of large public and commercial facilities. Targeting spaces such as commercial and government buildings, airports, conference venues, and highway rest areas, the ZC-01™ can operate in both manual and automatic modes to deliver efficient and hygienic cleaning at scale.

Equipped with non-visual LiDAR and infrared sensors, the robot performs adaptive navigation to clean toilets and urinals in a fully contactless way. Its integrated drying and UV sterilisation functions further enhance hygiene, while built-in systems record energy and chemical usage to support environmentally responsible cleaning practices. By reducing labour-intensive tasks and addressing work aversion in commercial cleaning, the ZC-01™ also offers practical social benefits alongside operational cost savings.

This breakthrough solution demonstrates how robotics can transform sanitation services by improving efficiency, sustainability, and working conditions, earning international recognition with a **Silver Medal at the 49th International Exhibition of Inventions Geneva**.

Teaching & Learning

Building Expertise in Water Treatment and Waste Management

The Department of Civil and Environmental Engineering offers specialised subjects that equip students with the knowledge and skills to address Hong Kong's pressing environmental engineering needs.

The subject "Water and Waste Management" provides a comprehensive understanding of environmental issues associated with water, wastewater, and solid waste. Students explore municipal water supply and sewerage systems, quality standards for potable water and sewage effluents, and the design principles of treatment facilities. They also examine physical, chemical, and biological treatment processes for controlling water quality, with a focus on sustainable waste management practices.

Building on the theoretical foundation, the subject "Water and Wastewater Treatment Techniques for Civil Engineering" focuses on the practical and technical aspects of water treatment, purification and wastewater disposal. Through laboratory work, students familiarise themselves with treatment methods for water, sewage, and sludge, and learn to design unit treatment processes. The subject also addresses operational, legislative, and sustainability considerations critical to modern engineering projects.

These subjects not only prepare students to formulate effective solutions, design and operate treatment facilities, and contribute to sustainable water and waste management in Hong Kong, but also help them hone analytical, creative, and collaborative skills essential for the profession.

External Engagement

Conserving Water Resources with Novel Fog Collection Systems

The PolyU Academy for Interdisciplinary Research hosted a seminar on innovative approaches to fog collection, offering fresh perspectives on tackling global water scarcity. Water shortage remains one of the most pressing challenges of our time, demanding sustainable design solutions that make better use of available water resources.

The seminar introduced a cutting-edge fog collection technology that employs microfibres fabricated through near-field electrospinning. Unlike conventional methods based on larger fibres, this novel design enhances collection efficiency to a record level. The interaction between fog droplets and micro-scale waterdrops on the fibres creates a unique airflow dynamic, enabling the system to capture and harvest fog with unprecedented effectiveness.

The hybrid seminar attracted **over 130 participants**, while live broadcasts engaged **around 13,000 online viewers** from more than 30 countries and regions, all of whom gained valuable insights into how interdisciplinary research can drive innovative responses to environmental challenges, particularly in ensuring sustainable access to clean water.

Transforming Rural Cambodian Lives through Sustainable Safe Water Initiatives

Hosted by the Department of Building Environment and Energy Engineering, the service-learning project in Cambodia enabled PolyU students from the subject "Living Environment for Low-Income Communities" to put their technical expertise into practice while contributing to community well-being. Partnering with

the Cambodian Children's Advocacy Foundation Organisation, the student team installed water filtration systems in a local learning centre, directly benefitting **over 300 children** in remote villages.

The initiative addressed pressing challenges of clean water access by introducing sustainable water treatment solutions that improve both sanitation and daily living practices. Beyond the technical installation, the project prioritised education and awareness-raising. Students worked alongside local youths and staff to conduct training sessions on system operation and maintenance, ensuring long-term reliability and empowering the community to manage their own resources.

This collaborative partnership not only secured safe drinking water but also sparked a broader community campaign promoting healthy practices, better public health, and sustainable consumption of water resources. By embedding education into every stage of the project, the team encouraged a sense of ownership among villagers, enhancing the likelihood of lasting impact.

Governance & Operations

Promoting Clean Water Access and Water-Smart Practices

Ensuring access to clean and safe drinking water and promoting sustainable water practices, PolyU has implemented a range of initiatives across the campus. **Around 70 drinking water dispensers** provide free, sanitised water, reducing reliance on single-use plastic bottles and supporting environmental sustainability, aligning with the principles of Responsible Consumption and Production (SDG12). Staff pantries are also equipped with hot water boilers, offering drinkable hot water to further minimise plastic waste while meeting the needs of the University community.

In parallel, the University has been advancing conscious water usage through measures under the Water Conservation Policy since 2014. Sustainable features are integrated into smart building design and refurbishment, including grey water reuse, careful management of water supply, and maintenance practices that reduce wastage. These initiatives raise awareness about water source and the importance of water conservation, encouraging the community to value water as a critical resource and understand the significance of careful extraction, treatment, and supply management.